

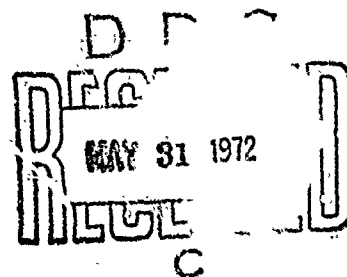
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METHODOLOGICAL ADVANCES IN POLITICAL GAMING: THE ONE-PERSON
COMPUTER INTERACTIVE, QUASI-RIGID RULE GAME

Martin Shubik

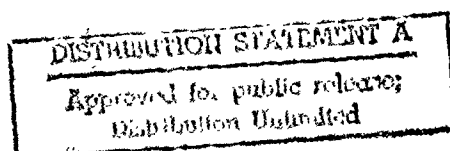
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METHODOLOGICAL ADVANCES IN POLITICAL GAMING: THE ONE-PERSON,
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Within a game we can specify all positions, all objects, all rules by which they are connected. In short, a game is a complete, self-consistent system in which people submit themselves completely to the rules.¹

I. STATEMENT OF THE PROBLEM

Why is there an attraction to the use of gaming for educational purposes? It is neither reasonable nor necessary to expect people to submit themselves willingly to prespecified and somewhat arbitrary rules, positions, and objects in a game setting.

This paper explores the reasons for gaming, some basic types of gaming, and it proposes a method for combining the strengths of two extremely different forms of gaming in a cheap and simple manner. Specifically it discusses the potential use of a one-person, interactive computer game that combines the features of rigid-rule gaming with free-form exercises.

WHY GAME?

For complex reference systems (such as most social settings) gaming affords the opportunity to reproduce a simplified but not

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¹Kurt W. Back, "The Game and the Myth as Two Languages of Social Science," *Journal of the American Academy of Arts and Sciences*, Vol. 8 (January 1963), pp. 66-71, at p. 68.

necessarily sterilized portrayal of both important whole system features and embedded, detailed, constituent elements. Furthermore, interactions between macro and micro events are clarified and their effects are intensified in the game setting. In short, a game offers one insights into both the structure and related outcomes of some simplified version of a reference system.

Recognizing that other methodologies also do exactly this, gaming's prime comparative advantage, however, lies in its inherent and reasonably well-established propensity to motivate and directly involve participants.²

Role-playing is an important motivational aid, and gaming, as compared with conventional teaching techniques, offers one insights into the human motivational elements generating outcomes.³ Such insights are converted into hard knowledge only with great ingenuity and usually by means of a well designed, executed, and analyzed experimental design.⁴

A third gaming rationale is that it forces the student to acknowledge the context. Indeed, making a game operate necessarily forces both game players, designers, and controllers to look some matters of fact squarely in the face.⁵

²See the rare evaluative efforts of James A. Robinson, F. Lee Anderson, Margaret G. Hermann, and Richard C. Snyder, 'Teaching with Inter-Nation Simulation and Case Studies,' *American Political Science Review*, Vol. 60 (1966), pp. 53-66; Anthony P. Raia, 'A Study of the Educational Value of Management Games,' *Journal of Business*, Vol. 39, No. 3 (July 1966), pp. 339-52; and Larry F. Moore, 'Business Games Versus Case Studies as Tools of Learning,' *Training and Development Journal*, Vol. 21, No. 10 (October 1967), pp. 13-23.

³We, of course, note experimental work on this matter. See, for example, M. M. Gold and A. C. Stedry, *The Effect of Role Playing in a Problem-Solving Situation* (Pittsburgh: Carnegie Tech., Graduate School of Industrial Administration, Reprint No. 196, 1964).

⁴A. C. Hoggatt, 'Measuring the Cooperativeness of Behavior in Quantity Variation Duopoly Games,' *Behavioral Science*, Vol. 12 (March 1967), and A. Binder, 'Learning and Extinction of Leadership Preferences in Small Groups,' *Journal of Experimental Social Psychology*, Vol. 3 (1966), pp. 129-39.

⁵It is reliably reported, for instance, that a major benefit of Joint Chiefs of Staff political-military gaming is just this rapid and enforced learning of specific details about real national contexts.

FREE-FORM VERSUS COMPUTERIZED GAMES: THE PROBLEM

There are two distinct forms or methods of games that have been used in undergraduate and graduate education. They are the free-form game used widely in sociology, political science, and social psychology, and the rigid-form, frequently computerized game used primarily in business school teaching and training, economics, operations research, and in the study of certain military problems.

Free Form

The free-form game is characterized by a scenario that provides a context within which play is developed. The political military exercise, inspired by the work of Herbert Goldhamer and others, provides an example of this type of investigation.⁶ A key feature of the free-form game is that positions, objects, and rules are challenged, created, and improved as the game proceeds. Directors and referees, who are often area or other experts, may prevent individuals from taking certain moves, but their actions may be challenged and debated. Thus in the "drama" of a free-form game, imagination and innovation play an important role. The exercise may be regarded as a type of brain-storming or interaction that enables individuals to see features of a problem not necessarily contained in the scenario. The quality of such exercises obviously depends upon the initial conditions and the nature of the referee or control. How good is the scenario? How professional are the players? How valid and inspired is the guidance of the control team, referees, and other contributing experts?

In terms of what a free-form exercise produces, there are two intimately related arguments that appear, but actually are not, mutually contradictory. Free-form games, it is argued, are non-scientific because they are not replicable and because they generate nothing that yields tangible research results. Analysis is not possible during play because the momentum of the game and the wishes of control override a researcher's desire to stop, speed up, or slow down activities

⁶ H. Goldhamer and H. Speier, "Some Observations on Political Gaming," *World Politics*, Vol. 12 (1959), pp. 71-83.

for his own purposes. Measurement, in effect, destroys or at least contaminates the thing being measured.

On the other hand, those who do have the necessary monitoring and recording equipment, lament that *too much* information for postgame analysis is produced and that there are few effective means to manage and analyze it.⁷ The issue seems to hinge on the identification of reasonable, interesting, and manageable units of observation. These two points of view hint that tangible research results can well be obtained from free-form games if one is able to figure out effective data management, reduction, and analysis procedures. The potential exists, but we have not yet tapped it.

Rigid Form

The rigid-form game is characterized by the prespecification of objects and rules that, taken together, determine the legitimacy of play and rigorously define the game. For many concepts and reference contexts such prespecification is a perfectly reasonable approach. For example, a rigid-form game may be derivable for some oligopolistic market settings because the structural, theoretical properties are understood.⁸ Such, however, is not the case for many matters in other social arenas.

Typically, rigid games are not substantively robust. Flights of fantasy and explorations beyond what is inherent in the defined and, in principle, knowable solution space of these games are just not tolerated, a fact that has led one historian colleague to term them "homogenized." In practice, particularly when a game is not well and cleverly designed, hostile reactions to the "stupid" game and play,

⁷Robert Noel, "The POLIS Laboratory," *in American Behavioral Scientist* (July-August 1969), pp. 30-35.

⁸Martin Shubik, *in* *Report on the POLIS Laboratory: Part II, Some Preliminary Observations on the Laboratory* (New Haven: Yale University, Department of Administrative Sciences. Report 36, 1970).

best described as attempts to learn and beat the program and game designer, occur with unfortunate regularity.⁹ Of course the significant objectives of the game are thereby lost sight of.

To attain scientific control over the game setting, capital investments in facilities, communication and computational equipment, and in the development of expert analysts and controllers may be considerable.¹⁰

Methodological problems associated with rigid-form games have direct substantive importance. The strategy and solution spaces are both finite and usually smaller than for free-form games. However, exploration of interesting alternatives or branches not specifically included in the game is not normally possible. So-called second-order effects -- the adjustment of a game's processing by modification of the internal arrangement of the game itself -- are limited. Creating new structures or branches during game play cannot easily be represented in a computer model -- the normal medium for this type of game -- in the present state of the art. (This is equivalent to producing a new statement in a computer program as a result of the execution of the others.) Inductive inference by machine might one day allow us to bypass this technical barrier, but at present we appear to be stuck with this methodological limitation.¹¹

⁹ See Harold D. Lasswell, "The Continuing Decision Seminar as a Technique of Instruction," *Policy Sciences*, Vol. 2, No. 1 (March 1971), pp. 43-57 for a fuller discussion of the problem and its several implications.

¹⁰ The extent of these investments is suggested by descriptions of laboratory facilities concerned primarily with experimental games. See for example, Noel, op. cit.; G. H. Shure and Robert J. Meeker, "A Computer-Based Experimental Laboratory," *Administrative Science Quarterly*, Vol. 14, No. 2 (June 1969), pp. 286-293; A. C. Hoggatt, J. Esherick, and J. T. Wheeler, "A Laboratory to Facilitate Computer-controlled Behavioral Experiments," *ibid.*, pp. 202-207; and D. M. Messick and A. Rapoport, "Computer-controlled Experiments in Psychology," *Behavioral Science*, Vol. 9 (1964), pp. 378-382.

¹¹ See Ronald D. Brunner and Garry D. Brewer, *Organized Complexity: Empirical Theories of Political Development* (New York: The Free Press, 1971), pp. 132, 137, 142-43, 153-55, for a lengthier discussion of these matters.

Creativity Versus Control

Generally, because there are fewer and less rigorous specifications of objects and rules for their interconnection, free-form games characteristically allow richer, more imaginative, and potentially more creative explorations of a context's problem space. On the other hand, such free-wheeling game play is pursued at a considerable cost in terms of greatly reduced control over the situation. Disagreements about the credibility and relevance of the scenario, lack of understanding and concern for the role of game directors, and overt attempts to play the directors instead of the game are all well known and, to some degree, pathological indications that a free-form game has gotten out of control.¹² Rigid-form gaming, on the contrary, is characterized by relatively good control over a context because positions, objects, and rules must be rather clearly and consistently specified to enable the game to play. Such control comes, however, at the expense of creative flights of fantasy. Here, too, sophisticated gamesmen may elect to play the program and disregard the substance that the game is meant to portray.

Restated and sharpened, the problem becomes the following: *How does one wield the strengths of each game form to extract their mutual benefits at optimal trade-off in sacrifices to the play, imaginativeness, interest, excitement, control, and evaluation of the game?*

II. THE ONE-PERSON, COMPUTER INTERACTIVE, QUASI-RIGID RULE GAME

One possibility, by H. A. DeNeer and Robert K. Meeker, developed from years of experience at The Rand Corporation and the System Development Corporation, and, more recently, at U.C.L.A.'s Center for the Computer-based Studies of Behavioral Sciences, is what we shall refer to as the one-person game.¹³

¹² H. A. DeNeer, *... (Santa Monica: The Rand Corporation, R-3535, February 1967)*, pp. 10-13. One must be alert to means for converting this negative motivation into more positive attributes.

¹³ Variants of the one-person game have existed for a number of years. For example, Gerald Shure and his associates at the System Development Corporation played a much simplified version some nine or ten years

DESCRIPTION AND CHARACTERIZATION OF THE ONE-PERSON GAME

In the one-person game as developed by DeWeerd and Meeker, the roles of all the teams except those of the United States are played through scenario extensions. A pre-game scenario sets the stage for the game and assumes that the Middle East crisis is not resolved through negotiations. It assumes that the Soviet-Arab bloc makes a decision in 1977 to force Israel to carry out the terms of the United Nations Resolution of November 22, 1967, calling for the Israeli evacuation of all Arab territory seized in the 1967 war.

The game involves thirteen Soviet-Arab military steps that progressively endanger Israeli security. At each step the Israeli Government makes a specific request for military aid from the United States. The U.S. player is offered a number of possible U.S. responses, which range from a stronger action than the Israeli request to no action at all. Seven responses are given for his choice and seven left open for the player to fill in if he chooses to do so. The purpose of the game is to reveal the stage at which the endangerment of Israel would lead the U.S. player to sanction large-scale direct military assistance to Israel.

In pre-game briefings, the U.S. player is assured that while he is participating in a rigid-form game, the control team function, exercised by various choices for scenario updates, will be responsive to actions chosen by the player. If the U.S. player resorts only to low-level actions, the predetermined series of Soviet-Arab steps is allowed to continue. If, on the other hand, the U.S. player elects to take strong stands or commits U.S. military forces to the assistance of Israel, the control team, making use of different scenario updates, will delay Soviet-Arab action, reverse previous Arab-Soviet actions, withdraw Soviet-Arab forces, or agree to a cease-fire.

ago. Adequate dissemination of the technique for public use has been quite recent, however. See Robert L. Meeker, Gerald H. Shure, and Rogers, A *Handbook of the One-Person Game* (Santa Monica: System Development Corporation, TM-731, June 25, 1962), for some very general references to the earliest beginnings of the one-person game.

During three or four intervals in the game, the U.S. player is given an opportunity to react to the course of play by indicating in response to a Delphi-like inquiry,¹⁴ his acceptance or rejection of the choices offered him. If he does not like the choices offered him or the framework developed for the game up to that point, he is invited to set down his own more relevant choices and the reasons why he thinks they are more relevant. He is thus offered the chance to function as a scenario writer or, if his departures from game design are great enough, as a game designer.

One of the great advantages of the one-person game is the short time required to execute it. By isolating the U.S. player, the interminable arguments about the proper choice of response, which always take place in multi-person teams, are avoided. With cooperative players, a run of the game, including a post-game briefing, can be accomplished in a single afternoon. Another great advantage is that once programmed for a computer, the game can be run off any number of times. After some familiarity with the game and the alternative scenario updates, the control team function can be carried out by a well-informed graduate assistant.

The game cycles come to the U.S. player in the form of teletype sections, which attempt to convey the impression of on-going activities. A sample of such a game cycle, the fourth, is set down for its illustrative value:

MIDDLE EAST DEVELOPMENTS

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March 15, 1975. The Chief Soviet delegate to the Warsaw Pact meeting surprised the world by announcing in a speech reported in Pravda that the Soviet Union was sending two tank divisions, two mechanized rifle brigades and two special anti-tank units to Egypt for desert training with UAR forces. There was no further explanation about the decision to send ground forces to Egypt. Their arrival in Egyptian ports in the early summer of 1975 was confirmed by Egyptian press reports. The Israeli Government took such

¹⁴See J. C. Dalkey, *et al.* (Santa Monica: The Rand Corporation, P-3704, October 1967), for an overview of that methodology.

a serious view of this development that the Prime Minister flew to the United States to present his government's views to the President. In meetings at the White House the Prime Minister said that his cabinet was convinced that the main purpose behind the Soviet Action was to provide through training and joint military action an example for Egyptian troops to follow. Conceivably Soviet tank and infantry troops might spearhead a cross-canal attack on the Suez front. The Prime Minister expressed the view that some dramatic American action would be required to offset the Soviet move and lessen the chances of a Soviet-Arab attack on the Suez front. He therefore requested that the United States send the 82nd Airborne Division to Israel for an indefinite stay. The President referred this request to the National Security Council.

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Intra-national Developments -- United States

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The Soviet Union Proposed that the SALT Talks which had been in recess be resumed. There was hope that the Soviet delegates to these talks would finally accept an overall strategic weapons agreement that the United States could live with.

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Seventeen U.S. Senators urged the President to send the 82nd Airborne Division to Israel on the grounds that the U.S. had troops in West Germany, the Philippines, South Korea, and Japan.

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Senator McGovern warned against being drawn into a "Mediterranean Vietnam" by sending U. S. shipments of arms or men to Israel. At the same time George Ball in a widely publicized speech at the National Press Club in Washington predicted that the U.S. would be driven out of the Mediterranean and perhaps ultimately out of Europe unless it maintained a measure of Israeli military superiority over the Arab nations and their allies, and unless it made unmistakably clear its determination to support Israel if necessary by sending ground and air forces. To take half measures would be to repeat the dismal way in which the U.S. became deeply involved in Vietnam. He repeated Lenin's saying: "Probe with a Bayonet until you hit steel" as proof that the Soviet would not be deterred by half-measures on the part of the United States. The McGovern-Ball statements highlighted the U.S. predicament in the Middle East.

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Situation Decision -- United States

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1. -----
2. The United States will agree to the Israeli request.
3. -----
4. The U.S. will send a number of officers of the 82nd Airborne Division for a visit to Israel.
5. -----
6. The marine landing battalion of the Sixth Fleet will be given a one-week shore leave in Haifa.
7. -----
8. The United States Vice President will visit Israel and assure its people that the US. is firmly committed to the survival of Israel as a state.
9. -----
10. The Sixth Fleet will be ordered to carry out extensive maneuvers in the Eastern Mediterranean.
11. -----
12. The U.S. will openly refuse the Israeli request.
13. -----

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Situation expectations -- United States

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1. -----
2. Soviets will attack Israeli cities with missiles and planes.
3. -----
4. The Soviets will make a large augmentation of their Mediterranean Fleet in order to reduce the influence of the U.S. Sixth Fleet.
5. -----
6. The Soviets will make a small augmentation of their Mediterranean Fleet to remind the United States of its presence in the Mediterranean.
7. -----
8. The Soviets will conduct amphibious training operations on the Egyptian Coast.
9. -----
10. The Soviets will sponsor an Arab summit meeting and issue a communique condemning the continued Israeli occupancy of territory captured in 1967.
11. -----

12. The Soviets will invite a large delegation of Arab leaders to visit Moscow.
13. -----
14. The Soviets will institute cultural exchanges with the Arab states.

Debriefings and postgame analysis are facilitated because the entire game record is available to the participants. Costs for each game run depend on the number of runs carried out. The greater the number, the less the cost of each run.

The pilot model for a one-player game exists. It has been through two trial runs. It combines some of the desirable features of free- and rigid-form games in a comparatively cheap form adaptable for the use of large classes in U. S. Foreign Policy or International Relations.

SOME INTERESTING FEATURES

There are many interesting aspects to the one-person game; however, several are worth detailed comment to indicate what results from the amalgamation of the rigid-and free-form game types.

An Evolutionary Data Bank

The generation, storage, and possibilities for data analysis are all enhanced by this game format. By defining the individual decision as the relevant unit of observation, a great number of individual game histories may be stored quite compactly. The idea is much like that which distinguishes a recipe from the finished culinary product. A recipe can be kept on a small card to be retrieved and used when needed, for it is absurd to keep finished products on hand to anticipate all contingencies. Likewise, instead of storing miles of video and audio tape game transcriptions, the "recipe" that could allow one to regenerate any given game is stored.

Each player generates a vector corresponding to his assessments and decisions at each step of the game. These data are coded, along with personal background information, and may easily be matched with various psychological and physiological measures. Far too little is

known about differences that age, experience, sex, risk level, uncertainty, and so forth make for game play and outcomes. At little additional expense these matters can be explored systematically and made more tractable.

One significant feature of this routine data collection is that it both grows and evolves. The data base can become a cumulative record of all games and game players, and it can change marginally as research or operational questions are refined.

On the Contamination of Individual Data

To capture and focus the individual player's motivation, during three or four intervals each is requested to write a small position paper on what is wrong or right with each step of the game. New branches on the scenario are thereby created for subsequent discussion, analysis, and incorporation into replays of the game. Individual players are given the opportunity to interact in a creative but controlled way with the game; the results are quite similar to a Delphi-like process and are designed to extract individual information from individual participants.

The value of this procedure is sharply contrasted with non-controlled and largely unaccountable interaction common to free-form gaming where social psychological pressures frequently dominate and limit the decision process and where individual player preferences are essentially lost for subsequent analytic efforts. The procedure is also distinguished from the rigid-form game because choices are not exclusively forced on the player. Does he accept the proffered menu as being the only things that could be done? If not, what does he want to do that is not included? One obtains a controlled sample of new information for each player that is not contaminated by group interaction processes.¹⁵

¹⁵In one well-designed experiment, it was found that group participation in fact impairs creative thinking as measured along several dimensions. See Donald W. Taylor, P. C. Berry, and Clifford H. Black, "Does Group Participation When Using Brainstorming Facilitate or Inhibit Creative Thinking?" *Administrative Science Quarterly*, Vol. 3 (1958), pp. 23-47. This issue is a real and still controversial one, however. See E. J. Hall et al., "Group Problem Solving Effectiveness under Conditions of Pooling vs. Interaction," *Administrative Science Quarterly*, Vol. 59 (1963), pp. 147-57.

Game Play as Scenario Creation

During pre-briefing, players have been warned that the rigid format is not to be taken too seriously. The game is consciously made into a learning, interrogative, and research device, thereby turning the joint weaknesses of free- and rigid-form games into a strength.

At every decision point players are provided an opportunity to create new choices, alternatives, or branches in the game. This procedure effectively addresses itself to the methodological limitation of rigid-form games by using humans during game play to create the second-order or structural changes.¹⁶ For many students, particularly where the level of sophistication and degree of motivation are quite low, no efforts will be made to modify a given scenario. This reluctance to create is in itself information about the student.

At game's end one will have for those who do expend the effort to create, an accurate record of where individual student imagination and perception of the reference context differ from that of the game designers and controllers.

What one has done is to force students to participate in the scenario writing process, a consideration of some pedagogic consequence. With the one-person game, play is constrained to a well-defined context while, exogenously, two-way information flows are allowed to flourish.

USES AND MODIFICATIONS OF THE GAME

By using a game in the fashion just outlined, a game designer benefits by having his scenario probed, so to speak, every time the game is played.¹⁷ For instance, one might try to upgrade a game by playing it with increasingly sophisticated players, beginning perhaps with high school or college undergraduates, progressing on to graduate

¹⁶ The Czech experimental theater, a popular success at the Canadian LXPO, is analogous.

¹⁷ Amateur war games effectively 'validate' minute detail in entertainment games in this same manner. See . . . (Baltimore: The Avalon Hill Company, periodical).

students, and then finishing with career foreign service and military personnel. At each iteration of the game, the scenario is not only played, it is reexamined and potentially corrected and improved. Hopefully, one engenders increasing amounts of popular acceptance -- to pick up an earlier theme -- or, similarly, decreasing levels of overt hostility as the game is played in this fashion. It may well be that for sophisticated, operational personnel, e.g. middle-grade foreign service and military, the postgame debriefing and analysis of game histories, position papers, and scenario amendments will have enormous educational and methodological payoffs.

III. SOME BENEFITS OF THE ONE-PERSON GAME

One objective of this exercise has been to emphasize the scientific aspects while suppressing what is best called the showmanship aspects of gaming. Specifically, how can the one-person game improve the existing state of methodological and pedagogical knowledge? What are potential avenues for development?

METHODOLOGICAL

Control over "loose and sloppy" free-form gaming may well be achieved with minimal degradation of game play. Indeed, being able to *replicate*, to replay a game under conditions of changed initial parameter values and to observe resulting differences in outcomes, is one definite advantage that adds considerably to the scientific aspects. Besides greatly improved control, the game design may evolve naturally and explicitly through a two-way process of creative scenario evaluation and construction.

Control: Specialized Postgame Analyses. A vector containing choices made at each decision point during the game is generated for each player. These data are compact and readily available for analytic manipulation. Control over the player type,

physiological characteristics exhibited during game play,¹⁸ or any of a long list of empirical possibilities can be exerted.

As a result of scenario evaluations and multiple plays of the same fundamental game, it is possible to explore local maxima and minima conditions and situations of more detailed interest, with respect to both behavior and the portrayed reference system. Key considerations are that individual records have been kept of all game plays and the format and structure of the game encourages repeated play.

Organizational problems and processes could be subjected to rather thorough experimental investigation. For example, group problem-solving activities might be studied by arranging players in teams whose internal structure and consequent behavior could be systematically studied via the game medium.¹⁹

Human factors, where the individual is regarded as both the subject and object of study, could also be developed in rigorous and interesting ways. We have already noted the ease with which physiological measurement can be combined with game play monitoring; this is a virtually untapped and wide open area of investigation.

Measuring the Impact of Perceptual Differences. Off-line forms that trace out new branches may stimulate the evolutionary development of better game scenarios. Different scenario types could be developed. For instance, write, and then have various players modify, a basic scenario to see how different antagonists perceive the world. Allison has reminded us that different perceptual styles make a considerable difference in how decisions are made in the world. It seems appropriate to begin more rigorous explorations of just what kinds of differences have what kinds of outcomes.²⁰

¹⁸Such data are routinely collected and analyzed in the Management Sciences Laboratory facilities at the University of California, Berkeley. See Hoggett, Lsherick, and Wheeler, op. cit.

¹⁹The XRAY series of games run at the Rand Corporation in the 1960s approximated this. See E. M. Paxson, *et al.*, *Group Decision Making* (Santa Monica: The Rand Corporation, 1964), p. 171.

²⁰Graham A. Allison, 'Conceptual Models and the Game', *Management Science*, Vol. 13 (September 1967), pp. 100-110.

Measuring the Impact of Game Director. Directorship styles are amenable to serious scrutiny. Who manages or controls a good game? What in fact distinguishes "good" from "bad" controllers? Is the director's role supervisory, participatory, antagonistic, supportive, or so forth? Just what difference does it really make for the game play and outcome? These questions are now reachable and researchable. They have not been so in the past.

Improving Programming Support. With sufficient generated evidence, it may be possible to learn how to do the necessary inductive inferential programming to account for second order or structural changes in game play. At the least, the empirical basis is provided to begin these difficult tasks.

EDUCATIONAL

It is not presently possible to detail who learns, how much of what, how well as a result of playing the one-person game, although the general contours are discernible.

What Teachers Can Learn. In approximately descending order of importance, teachers may learn about their students, the game (including the adequacy of the scenario), and the reference system. Learning about the students derives from the individual player data that are generated and hopefully analyzed. The potential for this learning is large, but converting this potential into knowledge depends critically upon teacher initiative, interest,²¹ and how well the scenario evaluation and refinement processes are managed.²² At the very least, instruction of this variety would be a cooperative venture involving both the teacher and the taught to a considerable degree. Finally, the theory that has been embedded in a game can be evaluated

²¹What makes an effective teacher is not well known and appears to remain so in the absence of suitable and consistent appraisal criteria. W. J. McKeachie, "Research on Teaching at the College and University Level," in N. C. Gage, ed., *Handbook of Research on Teaching* (Chicago: Rand McNally, 1963), pp. 718-72.

²²Jerome S. Bruner, *The Process of Education* (Cambridge: Harvard University Press, 1961), pp. 20-22.

by repeated student interrogation and evaluation; hopefully, inconsistencies and plain errors will be discovered and better theoretical approximations will result.

What Students Can Learn. By playing and recreating elements of a game, students are encouraged to learn about a represented reference system. The argument, the familiar one of model construction presented some time ago by one of these authors as opposed to model or game play, is where the large-scale educational payoffs exist in gaming and simulation.²³ Having to understand the explicit relationship of a game's objects, positions, and rules, a student is presented with a subject in much the same fashion as it originally confronted the creative scholar. But there is one assured and important additional factor: motivation. While what motivates the creative scholar is a separate and less certain matter, we know that game play heightens student interest and motivation as compared with conventional learning techniques.²⁴ It is the combination of this motivation with the creative processes of scenario evaluation and redesign that hold great educational promise. Finally, students could learn about one another depending upon what postgame analyses were conducted and whether the results of these were introduced into the course of study.

What Researchers Can Learn. Distinguish between the research and teaching roles. Researchers are provided a corpus of experimental data for postplay analysis that has heretofore been scarce or nonexistent. Measurement benefits are several and have been noted. Additionally, creating new branches to explore the problem space of a reference context may provide raw insights worth further refinement and investigation. The analogous argument is characterized by the "learning" aspect of problem-solving computer programs, e.g., chess, checkers, bridge-playing computer routines. As the program operates, less likely decision sequences or

²³Martin Shubik, ed., *The Theory of Games and Economic Behavior* (New York: John Wiley, 1964), p. 273.

²⁴S. Boocock and J. Coleman, "Games with Simulated Environments in Learning," *Journal of Educational Psychology*, Vol. 39 (Summer 1966), pp. 215-36.

"plays" are explored and evaluated; occasionally a more effective method of procedure evolves. The one-person game creates new branches explicitly and affords the researcher with the data needed to explore each of them in detail.

Specialists in organizational theory and behavior are afforded an experimental opportunity to observe group interactions and problem solving. What do individuals and organized configurations of individuals do under various controlled settings in the game environment? What *will* they do under various contingencies? What *should* they do? And so forth.

Finally, and perhaps only incidentally, the researcher obtains through repeated plays some information about the structural veracity of his game. Is it logically configured? Do the dimensions check out? Is the game producing anomalous responses? These and other questions of this variety can be determined. Questions about a game's validity and the degree of correspondence between the behavior generated by the game and that produced by the real system it reproduces may or may not be determinate, depending upon the availability of empirical data.²⁵

On the Scenario Writing Profession. The craft of scenario writing is critically important to the healthy development of gaming. We are seriously concerned by how few truly professional scenarists there are presently plying their trade. The species is certainly on some sort of intellectual "endangered list" -- most of the active professionals we know of are older men, and there appear to be no training or apprentice programs to pass on the "tricks of the trade" to the next generation. The one-person game, by virtue of its scenario-creating features, at least addresses the problem.

²⁵ See George S. Fishman and Philip J. Kiviat, *Digital Computer Simulation: Statistical Considerations* (Santa Monica: The Rand Corporation, RM-5387-PR, November 1967), pp. 14-20 for a cogent and accurate discussion of these much abused concepts.

IV. SUMMARY

The one-person, computer interactive, quasi-rigid rule game represents a significant advance in the methodological state of the gaming art. Hopefully it is the precursor of stronger, more scientific interest and activity in gaming for educational purposes.